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Monitoring snow avalanches with seismic stations in north-eastern Italy: a test case

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The Regional Agency for the Environmental Prevention and Protection of Veneto (Agenzia Regionale per la Prevenzione e Protezione Ambientale del Veneto, ARPAV) was established in October 2007 to monitor and prevent environmental risks in the Veneto region, in north-eastern Italy. The Italian National Institute for Oceanography and Experimental Geophysics (Istituto Nazionale di Oceanografia e di Geofisica Sperimentale, OGS), after the strong earthquake (magnitude $M=6.4$) occurred in 1976 in the Friuli-Venezia Giulia region, started to operate the North-East Italy (NI) seismic network: it currently consists of 11 very sensitive broad band seismic stations and 21 more simple short period seismic stations, all acquired in real time. OGS also exchanges seismic data with other Italian, Austrian and Slovenian agencies in the surrounding areas, which gives a total number of 73 stations acquired in real time. This makes the OGS the reference agency for the monitoring of the seismic activity in north-eastern Italy.

Detecting avalanches by means of seismic stations is indeed a difficult job because of the poor snow-to-earth coupling and the high dumping of the snow. In June 2007 OGS installed in cooperation with the Italian National Institute for Geophysics and Volcanology (Istituto Nazionale di Geofisica e Vulcanologia, INGV) a broad band seismic station in Agordo, a site located on the Dolomites mountains in Veneto. In the first half of December 2008, the Southern Alps have been affected by 2 episodes of intense snowfall: in the whole Dolomites, above the altitude of 1200 m, between 250 and 350 cm of fresh snow have fallen: similar snowfall events occurred in the last 80 years only in December 1979, 1960, 1959 and 1951.

The large amount of snow fell in the 2 episodes, on November 28th - December 6th and on December 10th-17th, failed to consolidate and for several days over a large part of the Alps the danger of avalanches was high (grade 4 out of 5 of the European level system). In the Dolomites, the area of interest of this work, the spontaneous avalanche phenomena was very intense, both during the snowfalls and subsequently. During the 2 periods several large avalanches have fallen reaching the bottom of the valley and were detected by the seismic stations: avalanches of such characteristics were not observed since 1987 (January) and 1977 (February). Given the intensity of the snowfalls, it has not been possible to date all the big avalanches, but only those closest to the towns. In this work we analyze the seismic recordings and relate them to the main characteristics of the avalanches.